FSB Development WBS

Revision History

04/01/03	First cut - developed from 582WBSModel020507.doc WBS Mode (Version 2.1)l: Roles columns added	
04/01/03	2nd cut, meeting with Elaine: Roles columns filled out Red text = suggested changes to WBS material.	
04/11/03 (a)	3rd cut, walkthrough with Elaine & Kequan (4/10/03): SM column changed to PDL (SM primarily concerned with oversight role on out-of-house projects.) S column deleted (normally not a separate role - exception is JWST) F column deleted - originally added for symmetry with D & T, but F not normally organized with lead + team. Numerous changes to assignments to roles. Some movement of WBS items prompted by role assignments.	
04/11/03 (b)	Identical to 4/11/04 (a) except: Section 2 (FSW Systems Engineering) entirely removed. All rows distributed according to where the Primary responsibility is - this is an experiment. (i.e., where the P was in the PDL column, that row moved to FSW Management; if the P was in the DL column, the row moved to FSW Subsystem Development.) All rows retain original numbering.	
04/15/03 (b)	4th cut, after walkthrough of 041103b with Elaine & Ray (4/14/03): Sections renumbered to adjust for removal of Section 2. A few rows moved from Development to Management/Engineering SRR, PDR, CDR, TRR, ATRR rows added. Many changes to Roles.	
05/06/03	Version intended for baselining at the next opportunity. New Tab added with WBS Diagram.	
05/08/03	Ver. 3.0	A few last minute changes from Kequan.
05/13/03	Ver. 3.1	Several wording changes in Section 2 after meeting with Stephe Leake (all simulator-related, no change to structure).
06/19/03	Ver. 3.1a	DCR #10 - No change to WBS contents - changes to the WBS key only: Clarification of the meaning of "P" and "S" in the Roles column. "Specialist" replaced by "Engineer" in role titles.
08/22/03	Ver. 3.2	DCR #17 - Updates to reflect changes in FSB Role names. Also, update to roles columns for WBS 1.15.8
09/23/03	Ver 3.2a	DCR #22 - Added TTL as support role for WBS 5.3
12/03/03	Ver 3.2b	DCR #33 - "Build Integration" (WBS 3.X.10) replaced by "Build Integration Testing". Diagram has similar change. (Never baselined)
12/09/03	Ver 3.3	DCR #34 - More changes to roll names.

FSB Development WBS Diagram

FSW Mgmt./ Engineering 1	FSW Dev. & Test Env. Engineering 2	FSW Subsystem Development 3	FSW Testing 4	Project HW Subsyst. Support 5	FSW Sustaining Engineering 6
• FSW Product Development Leadership • Task Planning • Build Release Planning • Task Technical Management • Contractor Management • Status Monitoring • Risk Management • Configuration Management • Change and Problem Reporting/Tracking • WVa. IV&V Coordination • Lessons Learned • FSW System Concept • Trade Studies & Engineering Analyses • Interface Requirements & Definition • Liaison	• FSW Development Tools • Desktop Simulators • High-fidelity Simulator(s) • External Component Simulator(s) • FSW Test Tools • High Fidelity Testbed(s) • Development Testbed(s) • System Administration • IT Security	• FSW Architecture Design • FSW Requirements Definition • FSW Requirements Review • FSW Preliminary Design • FSW Preliminary Design Review • FSW Detailed Design • FSW Critical Design Review • FSW Code And Unit Test • Data Base Development • Build Integration Testing	• Test Planning • Build Verification Testing • System Test Readiness Review • System Validation Testing • Acceptance Testing • Acceptance Test Results Review	• HW Diagnostics • Special HW/SW Tests • HW I&T Support • Observatory/ Payload I&T Support: - Environmental Tests - Comprehensive Performance Tests - FDC/RTS Testing - Mission Simulations - Functional Test Support - Contingency Test Support	• Pre-launch Preparations • On-orbit FSW Sustaining Engineering

FSB Development WBS vs FSB Roles

WBS FIELDS				ROLES					
WBS #	**WORK ITEM**	**DESCRIPTION**	**DELIVERABLES**	**PDL**	**DTL**	**DE**	**TTL**	**TE**	**STE /LM**
1	**FSW MANAGEMENT/ ENGINEERING**	**All task management and FSW system engineering activities**							
1.1	Flight Software Product Development Leadership	Technical and management oversight by FSB of all aspects of all flight software to be developed		**P**	S		S		
1.2	Task Planning	Development of WBS, work package identification, budget formulation, schedule formulation, staffing projection, resource estimation	Product Plan, Schedules Budgets, Cost Reports	**P**	S		S		
1.3	Build Release Planning	Definition of build sequence and schedule consistent with mission schedules, H/W arrival, FSW Lab readiness and I&T schedules	Build/Release Descriptions	**P**	S		S		
1.4	Task Technical Management	Technical coordination, direction and oversight of task engineering, development, testing and training activities	Input to Progress Reports	S	**P**		**P**		
1.5	Contractor Management	Task assignments, task evaluations, resource tracking.	Input to Progress Reports	**P**	S		S		
1.6	Status Monitoring	Status assessment, Metrics Capture, tracking, Project Reporting, 582 Reporting	Progress Reports, Metric Data	**P**	S		S		
1.7	Risk Management	Identification, evaluation, mitigation planning, monitoring and reporting of risk status	Risk Mgt. (or Product) Plan	**P**	S		S		
1.8	Configuration Management	Change control and configuration control processes; configuration item baseline tracking and repository.	CM (or Product) Plan	**P**	S		S		S
1.9	Change and Problem Reporting and Tracking	Discrepancy reporting system operation; discrepancy report disposition and administrative processing. Applies to FSW requirements, code, tools, simulators, and testbed hardware.	Problem Status Report, Problem Metrics	**P**	S		S		S
1.10	WVa. IV&V Coordination	Liaison with WVa. personnel to coordinate IV&V activities	MOA Inputs, IV&V Plan Inputs	**P**	S		S		
1.11	Lessons Learned	Collection of task information for Branch records used in estimation and process improvement for future missions	Project Experience File	**P**	S		S		S
1.12	FSW System Concept	Ground operations interaction, operating modes, external interface identification, FSW system features	Concept Document, FSW Subsystem Spec.	**P**	S				
1.13	Trade Studies & Engineering Analyses	Flight Data System architecture alternatives, protocol selection, data flow analyses, etc.	Engineering Reports	**S**	**P**				
1.14	Interface Requirements & Definition	Applications to C&DH, Spacecraft to SIs, Flight to Ground, Flight HW to Flight SW	IRDs, ICDs	**S**	**P**				
1.15	Liaison	Collaborative engineering with specialists for other mission components to understand and coordinate, interfaces, operational characteristics and requirements	Meeting Minutes, Notices, Technical Decisions						
1.15.1	Flight Data System H/W	CPUs, memory, data buses, interfaces		**S**	**P**				
1.15.2	Power	Batteries, solar arrays, Power Control Electronics		**S**	**P**				
1.15.3	Other Spacecraft Subsystems	Transponders, antennae		**S**	**P**				
1.15.4	Instruments	Data rates, command and status requirements		**S**	**P**				
1.15.5	Guidance, Navigation & Control	Sensor and actuator specifications, control laws, mode transitions, data processing and command generation		**S**	**P**				
1.15.6	Integration & Test	FSW delivery Plan, I&T specific hardware interface test software		**S**	**P**				
1.15.7	Ground Systems	Data base coordination, I&T and operations ground system compatibility		**S**	**P**				
1.15.8	Operations	Real-time and mission planning operations scenarios		**P**	S		S		
2	**DEVELOPMENT AND TEST ENVIRONMENTS ENGINEERING**	**Implementation/setup of all FSW development environments and test environments**							
2.1	FSW Development Tools	(Including CM System setup, DCR System setup)	Software, User's Guides		S				**P**
2.2	GDS Desktop Simulator Dev.	Pure s/w GDS with FSW and Ground System	Software, User's Guides		S		S		**P**

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2.3	GDS H/W in-Loop Simulator Dev.	GDS with interfaces to flight-like h/w	Software, User's Guides				S		**P**
2.4	External Component Simulator Dev.	Instrument Simulator, etc. (GDS or non-GDS based)	Software, User's Guides				S		**P**
2.5	FSW Test Tool Dev.	Data analysis/visualization tools (e.g., "Steve's Timing Tool")	Software, User's Guides				S		**P**
2.6	High Fidelity Testbed Integration	Hardware-in-the-loop, ETU	Software, User's Guides		S		S		**P**
2.7	Development Testbed Integration	Hardware-in-the-loop, breadboard	Software, User's Guides		S		S		**P**
2.8	System Administration	Configuration of development and test system equipment and licenses	Input to Progress Reports		S		S		**P**
2.9	IT Security	Firewall configuration, virus checking, backup integrity			S		S		**P**
3	**FSW SUBSYSTEM (X) DEVELOPMENT**	Typically, subsystem means C&DH, ACS or a Science Instrument. Thermal, Power and ACE may also be called subsystems. A task may have one or more subsystems. In this breakdown, X = subsystem name.							
3.X.1	FSW Architecture Design	Heritage plan, operating system, messaging approach, software layering, timing strategies, task structure, failover implementation strategy, commonality across multiple CPUs	FSW Architecture Design		**P**				
3.X.2	FSW Requirements Definition		Requirements Specification	S	**P**	S	S	S	
3.X.3	FSW Requirements Review	(May be combined with PDR)	FSW SRR Package	S	**P**	S	S	S	
3.X.4	FSW Preliminary Design		Preliminary Design	S	**P**	S			
3.X.5	FSW Preliminary Design Review	(May be combined with SRR)	FSW PDR Package	S	**P**	S			
3.X.6	FSW Detailed Design		Detailed Design	S	**P**	S			
3.X.7	FSW Critical Design Review		FSW CDR Package		**P**	S			
3.X.8	FSW Code And Unit Test		Software, Unit Development Folders (UDFs), Unit Test Reports		S	**P**			
3.X.9	Data Base Development		Data Base, Description Document		**P**	S	S		S
3.X.10	Build Integration Testing		Build, VDD		**P**	S			
4	**FSW TESTING**								
4.1	Test Planning		Test Plan		S		**P**		
4.2.X	Build Verification Testing	Verifies that the FSW build operates as designed and that all functional and performance requirements have been met. Test procedures designed and executed by the FSW test team on flight-like h/w (dry runs on breadboards, final on ETUs). In this breakdown, X = subsystem name.	Build Test Scenarios, Procedures, Reports				**P**	S	S
4.3	System Test Readiness Review	Confirms that test scenarios and testbeds are sufficient to comprehensively test FSW capabilities.	TRR Package				**P**	S	
4.4	System Validation Testing	Test scenarios designed by FSW test team, according to intended operational concept, with requirements traced to scenarios. System Test scenarios focus on operational capabilities of the system (both nominal and anomalous flight conditions): fully integrated software; configured as to be used operationally; executed on flight-like hardware (ETUs).	System Test Scenarios, Procedures, Reports				**P**	S	
4.5	Acceptance Testing	Acceptance Test is the ending event of the System Validation Test phase - execution of all System Tests on the final FSW build - Acceptance Test validates FSW is ready for Comprehensive Performance Test (CPT).	Acceptance Test Plan/Report				**P**	S	
4.6	Acceptance Test Results Review		ATRR Package				**P**	S	

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WBS #	**WORK ITEM**	**DESCRIPTION**	**DELIVERABLES**	**PDL**	**DTL**	**DE**	**TTL**	**TE**	**STE /LM**
5	**PROJECT HW SUBSYSTEM SUPPORT**								
5.1	HW Diagnostics	Special purpose diagnostic software to allow bench testing/debugging of flight hardware.	Diagnostic Software, User's Guide (optional)		S	**P**			
5.2	Special HW/SW Tests	Pre-I&T (informal)	Possible DCRs		**P**	S			
5.3	HW I&T Support	E.g., resolving interface problems during flight h/w integration	Possible DCRs		**P**	S	S	S	
5.4	Observatory/Payload I&T Support								
5.4.1	Environmental Tests		Possible DCRs		S				
5.4.2	Comprehensive Performance Tests	FSW is primary only for FSW-related portions of CPT (e.g, C&DH section, ACS section)	Possible DCRs		**P**	S	S	S	
5.4.3	FDC/RTS Testing		Possible DCRs				S		
5.4.4	Mission Simulations		Possible DCRs				S		
5.4.5	Functional Test Support		Possible DCRs		S				
5.4.6	Contingency Test Support		Possible DCRs		S				
6	**SUSTAINING ENGINEERING**		Sustaining Eng Plan						
6.1	Pre-launch Preparations	(Primary = MTL, supported by ME and others as indicated --->)	Tutorials, Software, User's Guide, FSW Lab H/W	S	S		S		S
6.2	On-orbit FSW Sustaining Engineering	(Primary = MTL, supported by ME)	Appropriate development and test documentation						

Role	
PDL	Product Development Lead
DTL	Development Team Lead
DE	Development Engineer
TTL	Test Team Lead
TE	Test Engineer
MTL	Maintenance Team Lead
ME	Maintenance Engineer
STE	Simulator/Tools Engineer
LM	Lab. Manager

(Includes testbeds, simulators, ground system, CM systems, DCR systems)

P Indicates the role that is primarily responsible for actually **performing** the work item, or most of the work item.
(Note that this is not necessarily the same role that is the point of contact for the work item. For example, in WBS 1.4 (Task Technical Management), the PDL would be the Project point of contact, but the DTL and TTL perform most of the detailed work.)

S Indicates roles that support or contribute to the work item, by performing part of the work, consulting, reviewing and commenting on the work, etc.